

Greater Suttle Lake Vegetation Management Project

Silviculture Report



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for:
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Deschutes National Forest
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Location

The project area is located in the vicinity of Suttle Lake in T13S, R08E, sections 24, 25, and 26. The area is accessed from Highway 20 and by Forest Roads 2066 and 2070. The project area is approximately 3,500-4,000 feet in elevation and about 249 acres in size.

Management Area

The project area is contained within an area of the Sisters Ranger District, Deschutes National Forest which is covered by the 1990 Deschutes National Forest Land and Resource Management Plan (LRMP) as amended by the Northwest Forest Plan (NWFP).

Under the 1990 LRMP, most of the project area (220 acres) is in Management Area (MA) 11, Intensive Recreation. The southeast corner of Unit 7 is within MA 8 General Forest (14 acres). Part of unit 7, East of Forest Road 2066, is in MA 3 Bald Eagle (15 acres). The land surrounding Blue Lake is private and is not part of this project. A map of the LRMP management areas can be seen in Figure 1.

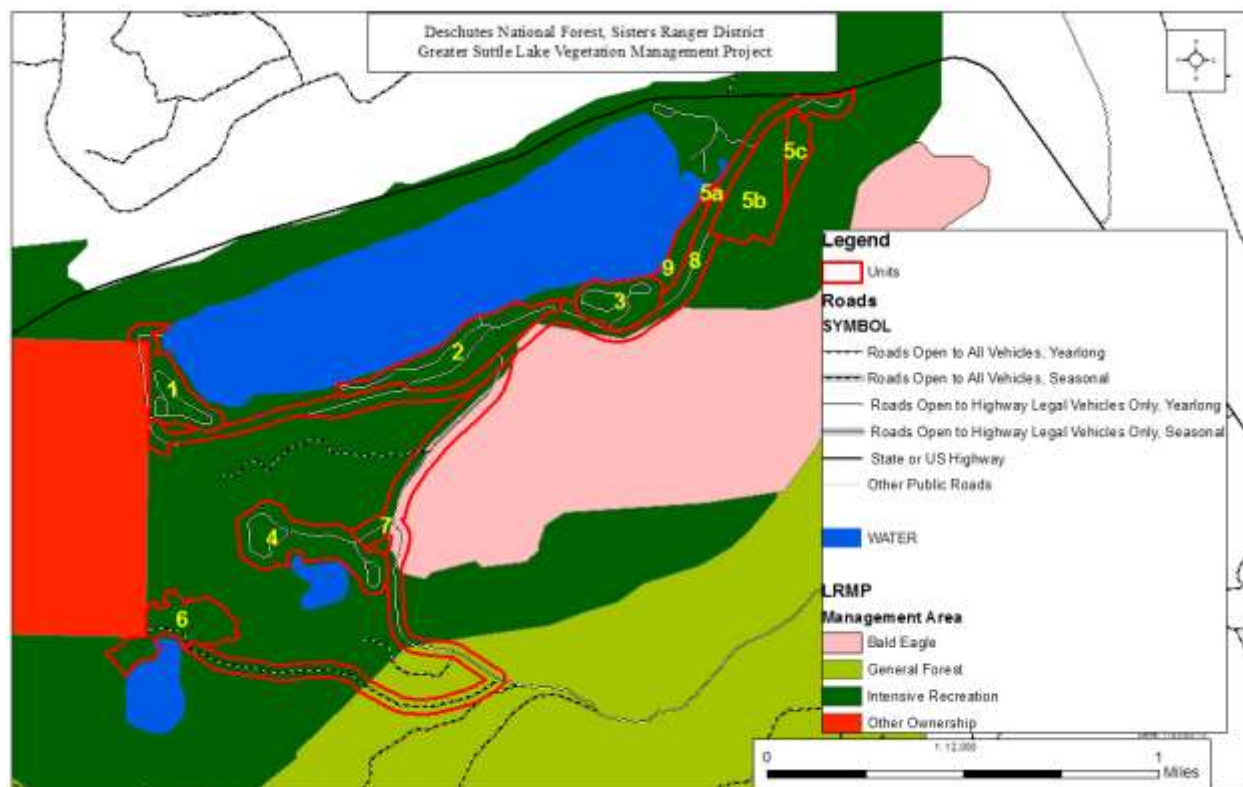


Figure 1. Suttle Lake Project Area with Land and Resource Management Plan Management Areas

Under the NWFP, most of the project falls under Administratively Withdrawn Areas (206 acres). Some of unit 7, east of Forest Road 2066, is within Late Successional Reserve (32 acres including part in Methodist Camp) and approximately 12 acres of unit 7 is within Matrix. The Northwest Forest Plan directs that acres under Administratively Withdrawn Areas be managed under the management area designated in the 1990 LRMP. A map of these land allocations can be seen in Figure 2. Not shown on the map is the Riparian Reserve land allocation, which applies to 320' from lakes, streams, and wetlands.

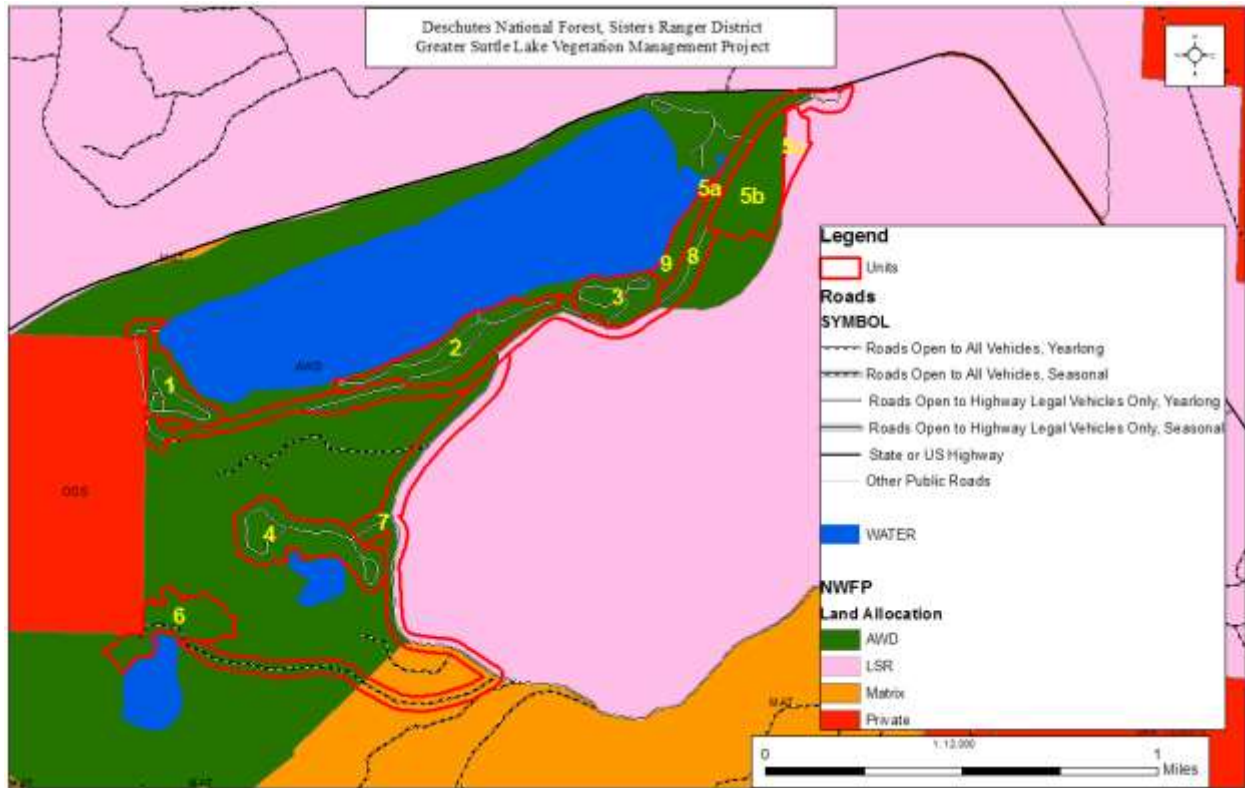


Figure 2. Suttle Lake Project Area with Northwest Forest Plan Land Allocations

The project is also located within a Wildland Urban Interface (WUI) as described in the *Greater Sisters Country Community Wildfire Protection Plan*.

Management Direction

The proposed project is consistent with management direction provided by the 1990 Deschutes National Forest LRMP as amended by the NWFP.

Northwest Forest Plan Direction

The project area overlaps with the riparian reserve land allocation under the NWFP. The project is in alignment with the standards and guidelines for the riparian reserve, which state: TM-1: Prohibit timber harvest, including fuelwood cutting, in Riparian Reserves, except as described below. Riparian Reserve acres shall not be included in calculations of the timber base.

a. Salvage trees only when watershed analysis determines that present and future coarse woody debris needs are met and other ACS objectives are not adversely affected.

b. Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain ACS objectives.

Under the Aquatic Conservation Strategy (ACS) section of the NWFP, the plan states “Improvement relates to restoring biological and physical processes within their ranges of natural variability.” The Suttle Lake project aims to restore the range of natural variability of Douglas-fir and white fir dwarf mistletoe within the highly disturbed campground sites and organizational camps of the project. This is

in alignment with ACS objectives because without treatment, these sites would lose most all of the large Douglas-fir and white fir on site over time. With a combination of pruning, felling of large and small infected trees, and planting dwarf mistletoe resistant species, many of the large fir trees that are currently uninfected with dwarf mistletoe will be maintained on site, long-term.

Part of the project overlaps with the Late Successional Reserve land allocation. One of the standards and guidelines for road construction and maintenance with LSR states: "Road maintenance may include felling hazard trees along road rights-of-way. Leaving material on site should be considered if available coarse woody debris is inadequate. Topping of trees should be considered as an alternative to felling." Roadside danger trees are proposed for felling and removal within the LSR land allocation along Forest Roads 2066, 2066600, and 2070. There is adequate down wood and coarse woody debris within this area of the project due to trees that have fallen down following the B and B fire from 2003. Topping of danger trees will be considered on a tree-by-tree basis where feasible and the remaining tree would not be a roadside danger tree.

Deschutes National Forest Plan and Resource management Plan Direction

Management area goals as well as standards and guidelines from the 1990 Deschutes LRMP would be followed under the proposed action and specific examples include:

Forest Health Goal: To maintain and enhance the vigor of the forest ecosystem through the control of forest pests.

Forest Health Standards/Guidelines:

- FH-1: It is the responsibility of the resource manager to consider, document and mitigate, if possible, the potential impact of forest pests, both on short and long-term land management objectives.
- FH-3: Management strategies should emphasize prevention of pest problems rather than suppression activities.
- FH-4: Treatment of pest problems should be a result of integrated area analysis to achieve quantifiable land management objectives. Treatment on an isolate stand by stand basis is not recommended.

Goals for the WUI include the safe egress of the public and the ingress of fire management equipment and personnel in the event of a wildfire. Road brushing would help with the safe egress and would be required under a timber felling and hauling operations contract.

Existing Condition

Most of the project area is part of the moist mixed conifer plant association grand fir/twinflower. This is a highly productive plant association which climaxes in a multi-story stand with large grand fir and Douglas-fir overstory. Most of the project area, within the campgrounds and organizational camps, is at this climax stage, which includes the death of trees due to insects, diseases, and density issues such as overcrowding of trees. A majority of the roadside areas (units 7 and 8) were affected by the B and B fire of 2003 which burned nearly 91,000 acres. Some overstory trees survived the fire, but the canopy was opened up and allowed light to penetrate to the surface where brush has dramatically increased. This

brush along the roads is a potential hazard in the event of another fire and it is not uncommon for fire areas to reburn.

The project area can be split up into 4 different unit classifications; roadsides (107 acres), campgrounds (86 acres), adjacent areas/stands (6 acres), and organizational camps (50 acres). Each of these unit types has been managed differently over time and thus contain varying levels of forest health issues and hazards. Within the entire project area, there are forest health concerns with Armillaria root disease (Figure 3), Annosus root rot, dwarf mistletoe in multiple tree species (Figures 4-5), white pine blister rust (Figure 6), Schweinitzii butt rot, *Echinodontium tinctorium* (Indian paint fungus as seen in Figure 7), Quinine conks (Figure 8), and red ring rot.



Figure 3. Mycelial fans indicating Armillaria root disease in white fir, Unit 9



Figure 4. Dwarf mistletoe in white fir in Methodist Camp, Unit 5



Figure 5. Dwarf mistletoe brooms in Douglas-fir at Camp Tamarack above parking area, Unit 6



Figure 6. White pine blister rust in Methodist Camp, Unit 5



Figure 7. Echinodontium tinctorium conk on a white fir hazard tree that was felled in Blue Bay Campground, Unit 3



Figure 8. Quinine conk in a Douglas-fir in Link Creek Campground, Unit 1

In the fall of 1999, 173 Douglas-fir with dwarf mistletoe were pruned within the project area and 55 Douglas-fir with dwarf mistletoe were not pruned in order to complete a study and a research paper titled *Pruning high-value Douglas-fir can reduce dwarf mistletoe severity and increase longevity in Central Oregon* was released in 2016 with the results. The authors found that 5 years after pruning 76% of the trees appeared to be mistletoe free but after 14 years that number dropped to 24%. Pruning generally had a positive effect on the trees' vitality but now, after 20 years most to all of those trees have grown their mistletoe brooms back. Some of those brooms are now so large and so heavy that they are breaking off of the trees and falling down to the ground, primarily under heavy snow loading or high wind events. "Douglas-fir dwarf mistletoe obtains water and nutrients from the host trees, weakening them and causing premature death (Mathiasen et al. 1990)." Once infections by dwarf mistletoe parasites become severe, trees can have significantly reduced growth and vigor, topkill and eventually trees often die as a result of these severe dwarf mistletoe infections and other stressors (Hawksworth and Wiens 1996).

Figure 11 is a picture taken in the spring of 2019 which shows freshly fallen mistletoe brooms below a Douglas-fir in the Scout Lake Campground. These brooms are currently a hazard to people camping, vehicles, trailers, and improvements such as restroom facilities. "Douglas-fir dwarf mistletoe infection significantly reduces tree life expectancy, slows tree growth rates, alters the normal form and appearance of trees, and substantially increases the potential of branches and trees breaking (Hadfield)." Figure 12 displays Douglas-fir dwarf mistletoe brooms in Link Creek Campground above camping sites.

Hazard Trees

The four campgrounds (Blue Bay, South Shore, Link Creek, and Scout Lake) have received the most hazard tree maintenance in recent history, being evaluated every 1-3 years. Hazard trees are assessed by using the "Field Guide for Hazard-Tree Identification and Mitigation on Developed Sites in Oregon and Washington Forests" 2014. Ratings for failure potential range from 1-4 and damage potential ratings also range from 1-4. The "Hazard Class" is determined by adding the failure potential and the damage potential together. Trees receiving a 7 or an 8 for Hazard Class are considered High or Very High for treatment priority and these trees are usually felled after evaluation for safety precautions within the campgrounds. "Eventually, hazard mitigation will result in the complete removal of the very trees that attracted user to an area. Without an organized plan for their replacement, which tailors the structure and composition of vegetation to match the growing conditions and management needs, these actions will lead to the destruction of the recreation resource that was the focus of the original development effort (Harvey and Hessburg, 1992)." Long-term planning for mitigation of current and future hazard trees and replacement trees is critical to maintaining recreation sites for the public.

Hazard trees within the two organizational camps are to be assessed and felled by the special use permit holders. Over the past 10-20 years, these hazards have been increasing as trees have been dying due to the diseases mentioned above. The hazard trees and infected dwarf mistletoe trees are at a magnitude where there is a need for action to mitigate the number of current and future hazards. Figure 9 is an example of a Douglas-fir branch, which had a dwarf mistletoe broom attached, that broke off from the tree and was lodged into the roof of a cabin at the United Methodist Camp. The mistletoe broom that was attached to the branch broke off and is now laying on the ground.



Figure 9. Cabin at United Methodist Camp with a Douglas-fir branch impaling the roof, Unit 5

Danger Trees

Roadside danger trees are assessed by using the “Field Guide for Danger-Tree Identification and Response along Forest Roads and Work Sites in Oregon and Washington” 2016. Various failure indicators are used to rate a tree with a “failure potential.” Trees with an “Imminent” or “Likely” failure potential have a high probability of failure within one to five years. Serious injury or death can occur when a danger-tree fails.

Figure 10 is an example of a danger-tree failure located within Unit 7, on the way to Camp Tamarack. The arrows point to the snag of a ponderosa pine tree where the top broke out and spiked into the ground on the opposite side of the road. In the picture there are other snags and dead tops visible that are currently a danger to motorists and public when accessing Dark Lake and Camp Tamarack. Douglas-fir with dead tops (≥ 3 inches in diameter) have a likely failure potential, for the tops (not the whole tree) if the tops have been dead 5 or more years. White fir with dead tops (≥ 3 inches in diameter) have an imminent failure potential, for the tops (not the whole tree) if the tops have been dead 5 or more years and a likely failure potential if the tops have been dead for less than 5 years. True fir trees like the white fir are non-resinous and will fail much quicker than Douglas-fir and ponderosa pine trees which are resinous and more resistant to failure. This type of information is highlighted in the Hazard Tree and Danger Tree guides and used to determine ratings for each tree.



Figure 10. Danger-tree failure, Unit 7



Figure 11. Freshly fallen dwarf mistletoe brooms at Scout Lake Campground, Unit 4



Figure 12. Douglas-fir dwarf mistletoe brooms in Link Creek Campground, Unit 1

There are many dead top trees within the project area, primarily in Douglas-fir trees around the Scout Lake area, that are remnant structures from a western spruce budworm outbreak in the late 1980s and early 1990s. Many of these dead top trees are located along the roadsides or above potential targets such as restrooms, parking spaces, and campsites (Figure 13). Where practical, these dead tops could be cut out with tree climbers or by use of a bucket truck, if the tree is otherwise not a safety hazard. This would help retain these otherwise healthy trees on the landscape after project implementation.



Figure 13. Scout Lake day use parking area with dead top Douglas-fir trees

Desired Future Condition

Long-term vegetation management planning is key to quality resource management and simply felling hazard trees does not take the long-term condition of the recreation site into consideration. There needs to be a balance between maximizing public safety, minimizing costs, and maintaining sustainability of the recreation resource (Harvey and Hessburg, 1992).

Currently the project area has an epidemic level of dwarf mistletoe in both the Douglas-fir and the grand fir. The desired condition would be to have endemic levels of these parasitic plants which would be approximately less than 20 percent of trees infected. Without removal of these infected trees, the parasitic dwarf mistletoe plants will continue to spread on to regenerating trees of the same species within 30-50 feet of the host tree. Many white fir in the project area are dead and dying due to Armillaria root rot and it is desired that these trees do not pose a safety hazard to people, motor vehicles, trailers, or infrastructure.

For campgrounds and organizational camps it is desired to have multiple age classes of healthy, vigorous trees that do not pose a safety hazard to recreating visitors, children and staff at the organizational camps, as well as improvements such as restroom facilities, cabins, amphitheaters, archery ranges, picnic areas, boat ramps, and campsites. It is also desired for these trees to be a mix of different species in order to have trees that are not susceptible to the diseases that are currently affecting the Douglas-fir and white fir like dwarf mistletoe and Armillaria root rot. White fir and Douglas-fir are also susceptible to the western spruce budworm which could have another outbreak similar to the one in the project area from 1985-1993. Some white fir and Douglas-fir are still desired, but at lower densities of more healthy trees. "When removing hazard trees, we may need to consider and plan for replacement vegetation to achieve the desired future condition of the site and the associated vegetation (Filip et al. 2014)."

Large trees of multiple species are desired in this project area. Pruning select Douglas-fir with dwarf mistletoe brooms could maintain some of these large trees on the landscape that are not severely infected and do not have dead tops. Douglas-fir with a Dwarf Mistletoe Rating (DMR) of 1-4 are good candidate trees for pruning (see pruning section for more detail). The Hawksworth (1977) DMR system is a common mistletoe rating system where you divide the crown up into thirds and rate each third 0, 1, or 2 based on the amount of mistletoe infection. A rating of 0 has no mistletoe and a rating of 2 is heavily infected. Then you add all 3 scores up to get the total score ranging from 0 to 6.

Meeting the Purpose and Need

Stand treatments, including sanitation harvest, pre-commercial thinning, planting, and pruning would provide long-term forest health by the removal of highly susceptible tree host species to parasitic plants and diseases. The removal of felled trees would provide safe campgrounds, roads, and organizational camps, as well as ensure appropriate fuel loading in the project area.

Many trees with lower dwarf mistletoe infection rates (DMR 1-4) would be pruned and remain on site. Trees not infected by Armillaria root disease or dwarf mistletoe that are more than 25-30 feet from infected trees of the same species would remain on site. This is in alignment with the CE category 220.6 (E)(14), which allows for removal of infested/infected trees and adjacent live uninfested/uninfected trees as determined necessary to control the spread of insects or disease.

A marking guideline and silvicultural prescription for the project area is included in Appendix A of this report with direct management recommendations from Oblinger and Flowers, 2019 included.

Effects

The campground units (units 1, 2, 3, and 4) and the roadside units (units 7 and 8) would have the least amount of felling and removal of timber and therefore less of an effect than the organizational camps (units 5 and 6). Forest stand structure would not change in units 1, 2, 3, 4, 6, 7, 8, or 9. Stand structure within the United Methodist Camp (unit 5) would change from old forest multi strata to understory reinitiation.

Unit 5 is a cool moist site with a multi-layered stand containing trees of many size classes and age classes. There are healthy trees, snags, and decaying live trees, as well as many infrastructure improvements such as cabins used for church camp and rentals, lodges, year-round residences, outdoor chapels/pavilions, etc. After treatment most of the snags and decaying live trees that are either hazards trees or heavily infected with dwarf mistletoe would be removed. This would create small openings (approximately .25 to 1 acre in size) outside LSR. These openings would be evaluated for planting of tree species resistant to dwarf mistletoe and Armillaria root rot in order to provide replacement trees where necessary. These planted trees would help the stand become resistant to the current forest health concerns that are causing hazard trees. Healthy trees would be left standing and healthy large trees would provide the old forest characteristic of the understory reinitiation stand structure. After treatment, there would still be trees of many size classes and age classes. There would be approximately 23 TPA felled in unit 5 with approximately 75 percent of those trees being heavily infected dwarf mistletoe white fir or Douglas-fir and approximately 25% being hazard trees.

Camp Tamarack (unit 6) would have approximately 15 TPA felled and removed with approximately 50 percent being heavily infected dwarf mistletoe white fir or Douglas fir and approximately 50 percent being hazard trees. Healthy trees would be left standing. Stand structure is currently young forest multi strata and would remain young forest multi strata because trees would be removed across all diameter classes. Small openings may be created and would be evaluated for planting of tree species resistant to dwarf mistletoe and Armillaria root rot in order to provide replacement trees where necessary.

The campground units would have approximately 3-10 trees per acre (TPA) felled and removed (live and dead). Trees would be felled for removal of hazard trees, removal of white fir associated with Armillaria root rot, and sanitation of dwarf mistletoe in both grand fir and Douglas-fir. Appendix B contains tree survey data per unit, displaying counts of hazard trees, danger trees, and dwarf mistletoe trees in each unit. These surveys are estimates and some additional trees may be identified during cut tree marking. Additional trees identified would be a small percentage of the total estimation.

Forest Roads 2066600, 2066, and 2070 would have approximately 4 TPA felled and removed for sanitation of dwarf mistletoe in both grand fir and Douglas-fir (outside of late successional reserve land allocation) and roadside danger trees. These roads are contained within units 7 and 8. Roadside danger trees with an imminent or likely failure potential would be felled and removed. Failure potential would be rated based on the "Field Guide for Danger-Tree Identification and Response along Forest Roads and Work Sites in Oregon and Washington" 2016.

Approximately 13 percent (32 acres) of the project area overlaps with late successional reserve land allocation under the NWFP. Most of these acres are found within the roadside units (units 7 and 8) and 6 acres is found within the northeast corner of the United Methodist Camp (unit 5). The proposed action would fell and remove danger trees from roadside units within the LSR and hazard trees from unit 5 within the LSR, therefore the effect to the LSR would be minimized. Dwarf mistletoe trees that do not rate out as hazard trees or danger trees would be retained within the LSR. Some of the Douglas-fir with dwarf mistletoe would be pruned within unit 5, where brooms overhang potential targets/infrastructure such as cabins, walking paths, ropes course, etc. This strategy to mitigate danger trees and hazard trees, while retaining a majority of trees dying of dwarf mistletoe would complement the direction given for the Suttle Lake Landscape Area within the Metolius Watershed Analysis, 1996. The goal for the Suttle Lake area within the watershed analysis states, "Maintain healthy mixed conifer stands that promote large tree character for bald eagles and provide well connected late-successional habitats: work to reduce conflicts between recreation uses and wildlife habitats."

Unit 9 would receive precommercial thinning of small diameter trees 1 foot tall to 8 inches diameter at breast height (DBH). Unit 9 falls within the riparian reserve and by precommercial thinning with hand tools and hand piling, impacts to the riparian reserve would be minimized. The forest stand condition would also be improved by culturing disease resistant tree species and cutting and piling of snowbrush. Healthy Douglas-fir trees greater than 50' from a Douglas-fir with dwarf mistletoe brooms or a freshly cut DF stump within roadside unit 8 would be a priority for retention. Trees over 8 inches DBH would be retained, as well as snags within unit 9. By favoring non-preferred trees of the western spruce budworm and non-host tree species of dwarf mistletoe in Douglas-fir and white fir, this stand will have much lower susceptibility to future budworm outbreaks and dwarf mistletoe infections. Also reduced tree densities will leave the residual trees more vigorous and more capable to fight off effects of defoliation and bark beetles in the future (Oblinger and Flowers, 2019).

Conclusions

The campground units (units 1, 2, 3, and 4) and the roadside units (units 7 and 8) would have the least amount of felling and removal of timber and therefore less of an effect than the organizational camps (units 5 and 6). Forest stand structure would not change in units 1, 2, 3, 4, 6, 7, 8, or 9. Stand structure within the United Methodist Camp (unit 5) would change from old forest multi strata to understory reinitiation. Planting of tree species such as rust resistant white pine, western larch, ponderosa pine, and incense cedar within gaps created in unit 5 will help restore the old forest structure over time. This will also help to make the stand resistant to the current dwarf mistletoe parasites and diseases like Armillaria root rot that are creating forest health concerns as well as hazard trees. "Having fewer dead and dying trees (and fewer tree parts at risk of breaking such as Douglas-fir dwarf mistletoe brooms and dead tops) would greatly reduce the risk to public safety in areas managed for intensive recreation" (Oblinger and Flowers, 2019).

Pruning

Pruning can be an effective method of controlling Douglas-fir dwarf mistletoe in campgrounds and special use areas. Pruning off infected branches and witches' brooms provides a way to reduce the effects of the dwarf mistletoe parasite, retains many large diameter Douglas-fir infected with dwarf mistletoe standing, and mitigates the hazard of falling brooms. Proper pruning does not kill trees. A

Douglas-fir should be considered a good candidate for pruning if it has all of the following characteristics:

- No visible mistletoe infections in the upper 1/3 of the live crown
- The tree is at least 40 feet away from the crown edge of overtopping dwarf mistletoe infected Douglas-firs that will be retained and not pruned
- The tree has a DMR of 4 or less and would maintain a minimum of 20% live crown ratio after pruning
- The tree is free of other defects that pose a high risk of failure

Branches with large witches' brooms are more likely to break than those with small brooms and climbing or use of a bucket truck may be necessary for pruning most mature Douglas-fir. Pruning large numbers of Douglas-fir trees should not be done from January to the end of June to avoid attracting Douglas-fir beetles. Pruning should be done July to December (Hadfield and Flanagan, 2000). The peak flight period of Douglas-fir beetles is April and May. The beetles may be attracted to the freshly pruned trees by resin flowing from the large pruning cuts and kill the trees. Beetles are not attracted to old resin.

Retreatment of pruned Douglas-fir trees will be necessary. One hundred-seventy three Douglas-fir trees with dwarf mistletoe were pruned in the Suttle Lake area in 1999 and at this time most to all of those trees have grown their brooms back. Latent infections at the time of pruning are often missed and left unpruned. These infections should be visible 3-4 years post pruning and they should be cut to avoid more infections from seeds produced by the newly emerged female plants.

Pruning practices should not flush cut branches. Branches should be cut up to the branch collar, the slightly swollen tissues right at the junction of the branch and the stem. Stubs should not be more than ½ inch long. Undercuts should be used on the large diameter branches to avoid tearing bark from the stems.

Pruning is not recommended for Douglas-fir with DMR of 5-6 or of trees where less than 20% live crown ratio would be left after pruning. These trees should be removed from the site as they most likely have large mistletoe brooms (often ≥ 10 feet in diameter) which are an overhead hazard. These large brooms often fail/fall under snow loading or high wind events.

References

- Filip, G. et al. 2014. Field Guide for Hazard-Tree Identification and Mitigation on Developed Sites in Oregon and Washington Forests. USDA Forest Service, Forest Health Protection, Pacific Northwest Region, Portland, Oregon. R6-NR-TP-021-2013.
- Filip, G. et al. 2016. Field Guide for Danger-Tree Identification and Response along Forest Roads and Work Sites in Oregon and Washington. USDA Forest Service, Forest Health Protection, Pacific Northwest Region, Portland, Oregon. R6-NR-TP-021-2016.
- Hadfield, J. *Management of Douglas-fir Dwarf Mistletoe in Forested Campgrounds and Other Developed Sites in Eastern Washington*. Wenatchee National Forest.
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_026436.pdf
- Hadfield, J. and Flanagan, P. 2000. *Dwarf Mistletoe Pruning May Induce Douglas-fir Beetle Attacks*. Western Journal of Applied Forestry 15(1):34-36.
- Harvey, R. and Hessburg, P. 1992 *Long-Range Planning for Developed Sites for Developed Sites in the Pacific Northwest: The Context for Hazard Tree Management*. U.S. Department of Agriculture, Pacific Northwest Region. FPM-TP039-92.
- Hawksworth, F. G. 1977. The 6-class dwarf mistletoe rating system. General Technical Report RM-48. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 7 p.
- Hawksworth, F.G. and D. Wiens. 1996. Dwarf mistletoes: biology, pathology, and systematics. USDA Forest Service, Agricultural Handbook 709. 410 p.
- Maffei, H. et al. 2016. *Pruning high-value Douglas-fir can reduce dwarf mistletoe severity and increase longevity in Central Oregon*. Forest Ecology and Management 379 (2016) 11-19.
- Mathiasen, R. et al. 1990. *Effects of Dwarf Mistletoe on Growth and Mortality of Douglas-fir in the Southwest*. Great Basin Naturalist 50(2), 1990, pp. 173-179.
- Oblinger, B. and Flowers, R. 2019. Greater Suttle Lake Vegetation Management Project – Forest Insect and Disease Evaluation. USDA Forest Service, Forest Health Protection, Central Oregon Forest Insect & Disease Center.
- USDA Forest Service. 1996. Metolius Watershed Analysis, Sisters Ranger District, Deschutes National Forest.
- USDA Forest Service. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl: Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl. USDA Forest Service, Washington Office.
- USDA Forest Service. 1990. Deschutes National Forest Land and Resource Management Plan. Bend, Oregon. Deschutes National Forest.

Appendix A. Draft Silvicultural Prescription and Marking Guide

Appendix B. Silviculture Tree Survey Data